

A map showing uranium concentrations (ppm) in soil at one of the FEMP locations.



The Radiation Scanning System can access areas where RTRAK cannot be used.

Operation

Successful deployments rely on the field integration of data from the various detectors and related components being used at a particular site.

- A computer on-board the RTRAK processes and displays the data received from the sodium iodide detector in real time.
- The GPS is integrated into the system to allow plotting of the data on the computer screen.
- The RTRAK operator knows the activity of radionuclides in any previously scanned vicinity, the precise location of all previous analyses, and the location of the vehicle in real-time.
- The operator can also monitor the gamma ray spectrum being acquired, perform preliminary quality control checks on the data, and monitor the GPS signal for satellite linkage.
- The data are transferred by radio-wave transmission to a mapping van in a nearby location. The data then receive an in-depth quality-control check. Finally, a field map is printed to support excavation decisions.

Subsequent Deployment

The *IIS* has broad applicability across the entire DOE complex, because gamma-emitting radionuclides have been identified in surface soils at many locations. Sites currently considering the deployment of the *IIS* include: Brookhaven National Laboratory, Idaho National Engineering and Environmental Laboratory, Mound Environmental Management Project, West Jefferson Proving Grounds (OH), two FUSRAP sites (Tonawanda and St. Louis), Ashtabula Environmental Management Project, West Valley, Rocky Flats Environmental Technology Site (903 Pad), Nevada Test Site, Oak Ridge Reservation, and Hanford. Future deployments at these sites are dependent on site-specific needs, funding, and relative cost savings against conventional baseline technologies.

Commercial Availability

The *IIS*, as a total system, is not commercially available. However, efforts are currently underway to identify a private-sector company to commercialize the system.

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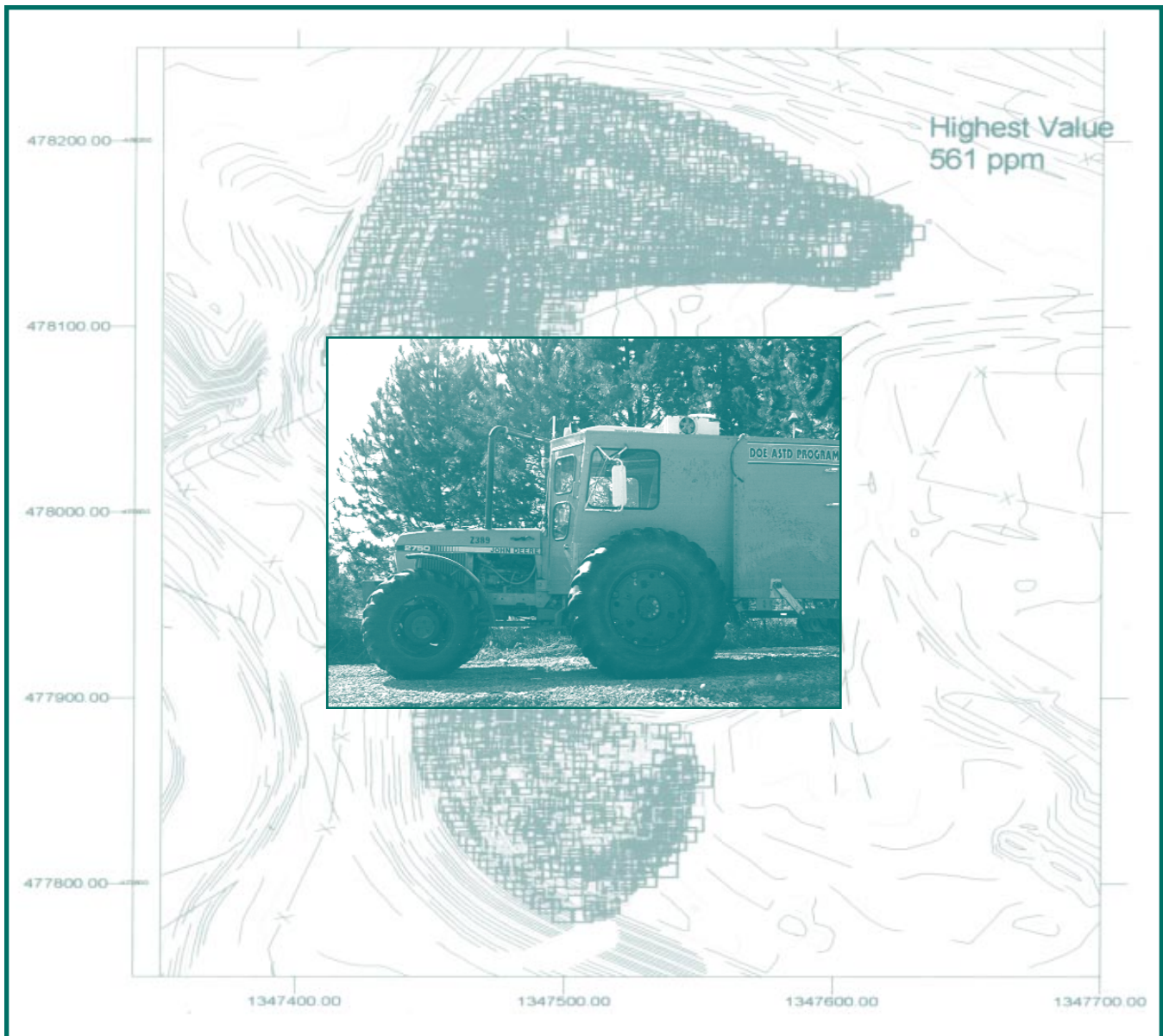
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T E C H N O L O G Y D E P L O Y M E N T



Integrated Technology Suite for Cost-Effectively Delineating Radioactivity in Soils to Support Removal Actions

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Office of Environmental Management
Office of Science and Technology
Subsurface Contaminants Focus Area

The Accelerated Site Technology Deployment (ASTD) Program funded 13 projects in 1998 and 32 in 1999. ASTD leverages funding with the DOE site cleanup managers to accelerate the deployment of available innovative technologies that can save money and time for environmental management operations. ASTD helps eliminate perceived business risks associated with new technologies by providing valuable cost and performance data to encourage multi-site deployment of these technologies, thus expanding cost-saving opportunities across the DOE complex. This project is one example of ASTD's success, where a multi-site team has contributed to accelerating the closure of the Fernald Environmental Management Project facility.

Problem

The Department of Energy (DOE) is faced with the task of remediating millions of cubic yards of contaminated soils throughout its nuclear weapons manufacturing complex. Cost-effective and timely identification and characterization of contaminated soils is essential to meet remediation schedules and budgets.

During operations extending from the 1950's to 1980's, multi-media contamination occurred at the Fernald Environmental Management Project (FEMP) facility in southwestern Ohio.

- > An estimated 2.6M cubic yards of contaminated soils are spread over more than 1,000 acres.
- > Primary contaminants of concern include uranium, thorium, and radium; secondary contaminants include RCRA metals and organics.

Problems such as these at Fernald are typical of many locations across the DOE complex. Because of the large volumes of radioactively contaminated soils at these DOE sites, identification of new cleanup approaches has great potential to save significant dollars.

Solution

To meet this challenge, DOE has integrated three characterization and mapping technologies into a system designed to detect and map radionuclide contamination in soils. Real-time analysis and visualization allows for application of the technology during soil removal operations. Application of this new real-time system has reduced soil excavation costs due to a reduction in the volume of soil requiring an expensive disposal option.

The new system, called the *Integrated Technology Suite (ITS)*, utilizes commercially available components (two types of gamma detection devices, communication and mapping devices, and new software) in an innovative configuration to collect real-time data. Analytical and locational data are acquired in real time, and color-coded contamination maps are generated in less than thirty minutes after data collection is completed. The field screening system replaces the high-cost and labor-intensive soil sampling and laboratory analysis program previously established as the baseline at FEMP.

Status

The *ITS* has been routinely deployed in the field to support soil excavation activities at FEMP since July 1998. Regulatory approval (for waste acceptance criteria and pre-certification) to use the system as a field screening tool has expedited its use. *ITS* has been deployed in four campaigns at FEMP: Area 2 Phase I, Area 2 Phase III, Area 8 Phase I, and Area 8 Phase II to expedite the excavation process, resulting in significant savings.

Optimum Application

- > These technologies should be considered for application at sites requiring measurement of gamma-emitting radionuclides (e.g., U^{235} , U^{238} , Ra^{226} , & Th^{232}) in surface soils. *ITS* can be used during initial site assessment or to support soil removal actions by minimizing the amount of soil required to be removed.

Technology Limitations

ITS is not well applied at sites with:

- > inclines greater than thirty degrees
- > highly wooded areas
- > soil moisture content >30% (laboratory moisture equivalent)
- > high background radon concentrations in surface soils
- > "shine" from near-by radioactive sources
- > gravel in the shallow subsurface.



The High Purity Germanium Detector is used to map "hot-spot" radioactive soil contamination.

Baseline

IIS has contributed to reducing costs and accelerating schedules at FEMP, with the accelerated plan calling for the majority of the remediation work to be completed by FY-2006.

Costs and Cost Savings

The estimated cost savings depicted in Table 1 are more accurately described as “baseline reductions” or cost-avoidance benefits, resulting from the deployment of IIS. Preliminary estimates using data from Areas 2, and 8 predict that cost savings will yield a return on investment (ROI) (for the Office of Science & Technology funding) of >10:1 by FY-2006 and total cost savings of \$34M.

Table 1 - Projected Cost Savings to be Realized by FY-2006*

Estimated Cost of Baseline Method	\$51M
Estimated Cost of Real-Time Method	\$17M
Estimated Total Cost Savings	\$34M
ASTD ROI (Approximate)	10:1

*Source: “Estimated Cost for Delineating Remedial Activities at the Fernald Environmental Management Project Using Conventional and Real-Time Approaches,” June 1998

Technology Description

IIS is based on three components of radiation detection equipment:

- 1) Mobile Radiation Tracking (RTRAK) system with sodium iodide detectors and a Global Positioning System (GPS) mounted on an enclosed agricultural tractor vehicle to be used in a screening mode to rapidly detect and locate gamma-emitting radionuclides;
- 2) Radiation Scanning System (RSS), a smaller version of the RTRAK mounted on a baby carriage to expand the types of applications for which the technology can be used (e.g. slopes that the tractor cannot access or small sites where a detailed screening is required); and
- 3) Portable High-Purity Germanium (HPGe) sensors for detailed delineation of hot spots identified by the RTRAK or RSS.

RTRAK provides qualitative and quantitative gamma-surveying capability, which allows large tracts to be quickly screened. Measurements are reported as gross and individual isotope activity levels.

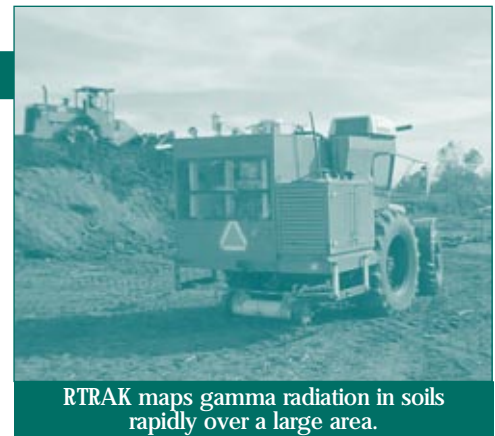
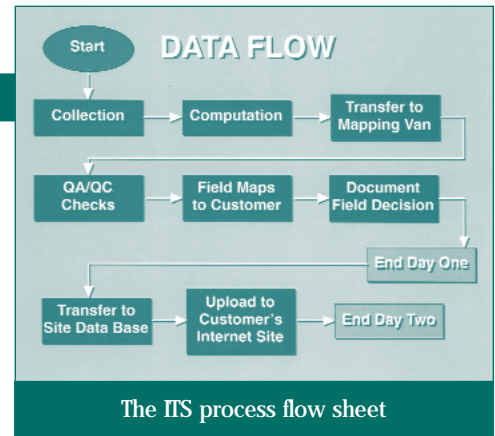
HPGe detectors are tripod-mounted for use in performing accurate measurements of a wide-range of gamma-emitting isotopes at hot-spot locations first delineated using either the RTRAK or RSS. The HPGe detectors provide quantitative measurements in a timely fashion at reduced costs as compared to the baseline, which uses field sampling and laboratory analyses. Another advantage to HPGe is the viewing window that provides spatially averaged interpretations, rather than discrete samples.

In addition, IIS uses new software, partially developed by INEEL, to provide automated data reduction/quality control and 3-D location tracking capabilities.

Performance

A performance comparison of the baseline characterization method to IIS can best be illustrated using a hypothetical example:

- If one physical sample is required for every 100 ft² to adequately characterize an area of one acre, then 440 discrete samples would need to be collected per acre. One sampling team could not collect this number of samples in a full eight-hour day. Sample preparation, shipping, documentation, and laboratory analysis would add further to the time required for data to be reported. Associated costs for sampling and analysis are related to the time required to perform the work.
- IIS can complete data collection to characterize the same site and produce color-coded maps in as little as 22 hours.



RTRAK maps gamma radiation in soils rapidly over a large area.



The High-Purity Germanium Detector can easily be moved from one “hot spot” to the next.